DOCUMENT RESUME

ED 182 804 EA 012 375

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TITLE Perspectives on School Energy Use.
PUB DATE 79
NOTE 38p.

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Bus Transportation; Cost Effectiveness; *Differences; Elementary Secondary Education; *Energy Conservation; Expenditure Per Student; *Fuel Consumption; *Fuels; Heating; National Surveys; *Regional Characteristics; School Districts; *School Improvement; School Integration; School Law; Student Transportation; Tables (Data)
IDENTIFIERS North Carolina

ABSTRACT

This paper offers a general perspective of school energy use based on national surveys and a state of North Carolina perspective based on the public school laws that can have energy impact. Data from two surveys conducted in 1972-73 and 1974-75 are analyzed. Findings show a shift away from oil and a shift from direct use of coal to use of electricity generated from coal. Districts greater than 5,000 pupils use proportionately much greater amounts of coal and propane. A study of average energy costs per pupil compiled for selected years from 1969-78 shows energy costs over the period have increased almost 322 percent. Not all of the energy cost increase over the period 1972-78 was due to increased fuel costs. Some data exist showing pre- and post-desegregation transportation costs. Other energy costs are due to the lack of life cycle costing in schools built in the 1950s and 1960s. Measures that school districts can take to save energy are discussed. The last section of this paper contains a brief description of North Carolina laws and their potential impact on school systems within the state.
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ED182804

PERSPECTIVES ON SCHOOL ENERGY USE

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Education 335
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Fall Term, 1979

EA 012 375

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I. GENERAL PERSPECTIVES

On any particular school day in this country, approximately twenty-five percent of the population in engaged in that active pursuit called education.[1] The segment of the population involved rides to school in private cars and public buses or walks. The cost to the public for bussing (both forced and otherwise) is five hundred million gallons of gasoline.[2] The cost to the nation as a whole, in terms of gasoline, is not calculable without a great deal more information than we currently have. If it were assumed that a school's cost for gasoline would be equal to $0.70 per gallon, this cost would equate to $7.00 per pupil per year. As prices for fuel continue to escalate, the dollar cost will increase. Each $0.01 increase in the price of gasoline will cause the national school gasoline cost to rise by about five million dollars!

Not only must energy be expended for the transportation of students to and from school; it must also be expended for maintaining climate control for the students once they arrive at the school building. Various estimates exist as to how much energy is consumed in this <u>space conditioning.</u> The estimate of eleven percent of the nation's total space conditioning costs allocated to schools has been one accepted figure.[3]

Even after the students are transported to school and kept there in more or less comfort, there are curricula which demand the further use of energy. Perhaps the most significant energy consuming course

is driver's education. This course, according to one estimate, uses eighteen million gallons of gasoline per year.[4] This is in addition to the five hundred million used in school bussing, and the countless gallons expended by private vehicles transporting students. Courses, other than driver's education, require energy expenditures. For example, home economics, shop, computer science, and typing all require additional amounts of energy. At some future time it might be necessary and prudent for administrators to evaluate the necessity of and benefits from these particular academic areas.

One author sees new words being derived from the new energy conscious era. One word is UNERGY. This word means the outright denial that a real energy crisis exists. The second word is MONERGY, and it means the dollars saved through conservation programs.[5] Whether one choses to use these new coinages is not important. The really important factors are that everyone does not agree that a real problem exists, hence the unergy crisis, and that dollars can be saved if conservation programs are successful, hence monergy.

Dollar costs for all aspects of a school's program have risen along with the general cost of living. Energy costs have risen faster than some other program costs and, from an energy cost basis, there appears to be no end to price increases. The ultimate result of energy cost increases in absolute areas (getting the student to school and providing a healthy and safe environment at school) will have an impact on school program and on teacher salary.[6] These impacts are currently not known but logic dictates that if cuts are to be made, they will be in program and salary. These two areas are less essential than transportation and space conditioning.

Organizationally this paper will have a general perspective of school energy use based on national surveys and a state of North Carolina perspective based on the public school laws which can have energy impact.

There are several different ways to divide the country for purposes of energy study. One way that has been chosen by several researchers and utilized by the American Association of School Administrators (AASA) seems, perhaps, the most logical. The AASA scheme accepts the Federal Energy Administration's ten regions. Figure A. shows the various regions.[7]

Following the Arab oil embargo of 1973-74, concern over energy availability grew very rapidly. Ed Stephan, one of the researchers doing energy analysis at the time, sampled schools in the ten national regions. The total sample was of four-hundred-ninety-eight school districts. School districts sampled were classified into six size groups ranging from fewer than one thousand pupils to those with more than twenty-five thousand students.[8]

A study of the data which the Stephan survey collected and the information amassed by the AASA in a more recent survey is quite illuminating as to current energy trends.

The two surveys were done with a somewhat different set of questions; therefore, their results are not directly comparable. Each survey does, however, address the general energy problem and, by doing so, provides some useful information. The general survey results are provided in Figures B and C.

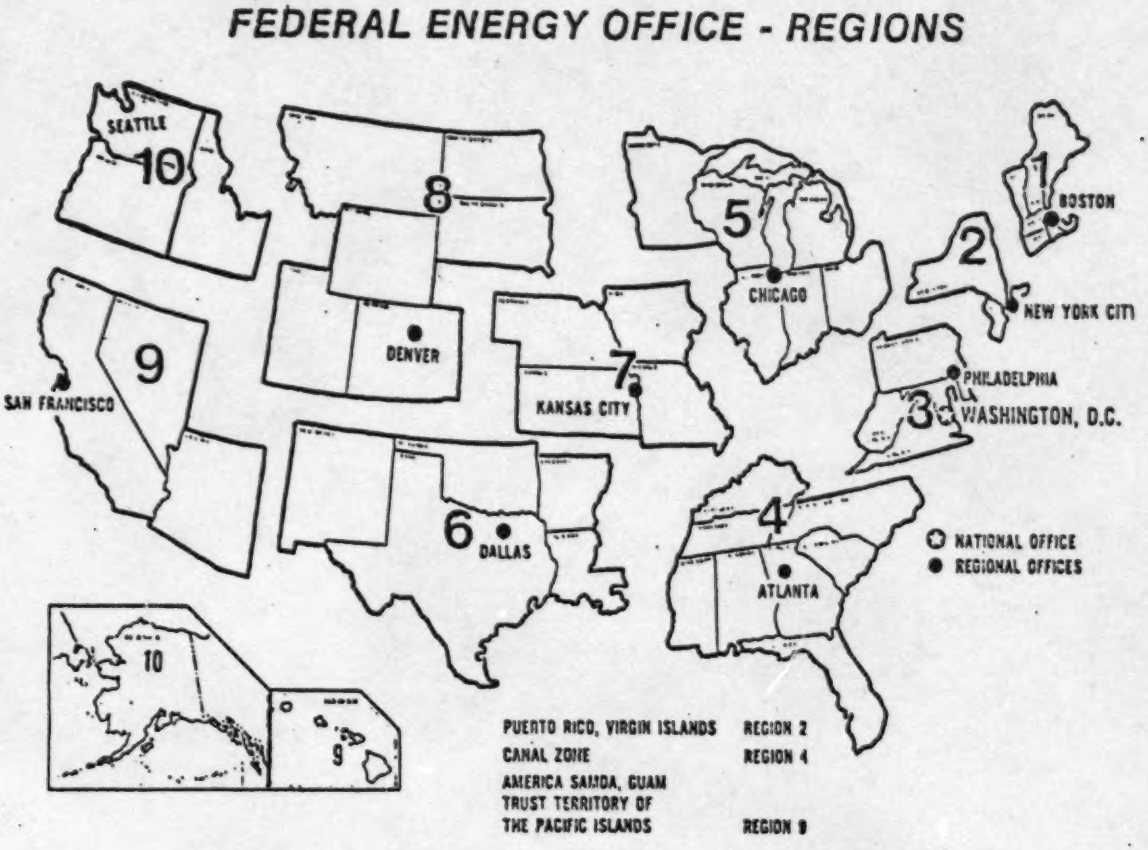

FIGURE A. MAP SHOWING REGIONAL BREAKDOWN

Energy Type	1972-73	1974-75	% Change
Fuel Oil (gal.)	37.17	33.33	-10.3
Natural Gas (CF)	5694.48	5813.01	2.0
Coal (tons)	0.10	0.07	-30.0
Electricity (Kwh)	507.60	558.80	10.0
Propane (gal.)	2.04	1.64	-19.6

FIGURE B. COMPARISON OF PER CAPITA PUPIL ENERGY CONSUMPTION

(72-73) TO (74-75) [9]

Table 6. Fuel Source by District Size;
Number of Bldgs & Percentages

	Less than 600 n = 419		600 to 4999 n = 2996		5000 or more n = 7353	
Fuel Type	n	%	n	%	n	%
Natural Gas n = 5999	154	37	1446	48	4327	59
Oil (all grades) n = 2734	103	25	732	24	1853	25
Electricity Htg/cooling n = 809	20	5	254	8	528	7
htg only n = 962	72	17	341	11	524	7
(cooling only) n = 852	(19)		(153)		(671)	
Propane n = 220	47	11	138	5	28	.4
Coal n = 168	11	3	78	3	77	1
Butane n = 19	9	2	-		10	.1
Diesel n = 16	3	.7	7	.2	6	.08

FIGURE C.10

The per capita student consumption provided by Stephan in Figure B, is demonstrative of a general trend which seems to manifest itself. As certain energy sources become more expensive or less available, switches occur to different sources. Figure D has been compiled using Stephan's data. This figure shows quite clearly the shift away from oil which occurred after the Arab oil embargo.

	1972-73	1974-75	Difference
Fuel Oil	26%	24%	-2
Natural Gas	30%	32%	+2
Coal	13%	9%	-4
Electricity	30%	34%	+4
Propane	1%	1%	0

FIGURE D. PERCENTAGE OF TOTAL ENERGY CONSUMPTION (IN BTU'S) BY TYPE

Figure D also clearly shows a shift from coal as a direct use to use of electricity generated from coal.

Analysis of the data from the AASA information presented in Figure C reveals that differences in school district size have a relationship to fuel source used. Districts greater than 5000 pupils use proportionately much greater amounts of coal and propane. That these differences exist is probably due to where large districts are located (urban areas) and can, perhaps, be explained by citing air pollution considerations in reference to coal use and greater availability of piped natural gas negating the need for bottled or propane gas. Size of a school district is certainly not always correlated with being in an urban area, but in many cases this correlation does hold true. Using the same logical argument that smaller districts tend to be more rural, one would expect smaller districts to use more electricity due to its greater accessibility.

The AASA survey, as evidenced in Figure C, shows districts with less than 600 pupils use about 63% more electricity than the largest districts. A further check can be made of the validity of the urban-rural and size relationships by checking a fuel source which has no overt air pollution considerations and no overt shipment advantages or disadvantages--oil. Checking AASA's numbers in Figure C shows basically no variation in oil usage among the various sized districts.

Variations exist not only among different size districts, but also among the districts of the same size. The AASA survey also sampled the districts' percentage of fuel usage. This data is shown in Figure E. According to the sampling data, 10,929 buildings were sampled.

Analysis of the data found in Figure E shows very obviously that fuel type differences among regions are substantial. This knowledge is very important in developing energy plans at the national level. Any activity which causes price increases or disruptions in natural gas supplies will impact schools in region 9 most severely, with regions 6,7,5,4, and 8 being substantially affected. Region 1 would have the least disruption from fluctuation in natural gas supply. Figure F. displays regional highs with respect to fuel sources. Since any fuel source which provides more than 20% of a region's energy is very important, these figures are also shown. (All numbers in Figure F are drawn from data in Figure E.

Percentage of Fuel Sources, Federal Energy Region:

Fuel Type	Federal Energy Regions									
	1	2	3	4	5	6	7	8	9	10
Natural Gas N= 5999	11	19	19	58	61	79	60	51	84	19
Oil (all grades) N= 2734	79	69	65	13	23	0.5	21	8	4	61
Electricity Htg/Cooling N=809	4	2	7	10	5	1	7	6	4	7
Htg. Only N=962	5	9	4	12	7	6	6	30	6	9
Propane	1	0.2	0.1	5	0.5	1	5	3	1	0.6
Coal	0	0	4	2	3	0	0.8	1.6	0	1.4
Butane	0	0	0	0	0	0.9	0	0	0.2	0
Diesel	0	0	0	0	0	0	0	0	0.4	2
All Fuels Total	303	418	1318	1857	1979	1730	764	683	1237	638

FIGURE E. 11

Types	Regional Maximum	Region with >20% Reliance
Natural Gas	9 (84%)	8,7,6,5,4
Oil	1 (79%)	2,3,5,7,10
Electricity	8 (36%)	4
Propane	4,7 (5%)	-
Coal	3 (4%)	-
Diesel	10 (2%)	-
Butane	6 (0.9%)	-

FIGURE F. FUEL SOURCES - MAXIMUM USE AND 20% FIGURES

Not only is it important to know regional differences when deciding on national energy policy, it is necessary to know, at least generally, what percentage of the total nation's schools use what particular fuel source. Figure G shows the national break down of fuel types as found by the AASA survey.

While schools are, and should be, concerned with energy consumption, another factor enters heavily into administrative decisions--cost. Cost comparison figures are hard to interpret unless there is some common conversion unit applied to gallons, Kwhs, cubic feet, and tons. The format suggested by Stephan is to use the British Thermal Unit (BTU) as the common unit. His conversion factors are shown is Figure H.

Fuel oil, 1 gallon	= 138,700 BTU
Natural gas, 1 cu. ft.	= 1,031 BTU
Electricity, 1 Kwh	= 11,600 BTU
Coal, 1 ton	=24,580,000 BTU
Propane, 1 gal.	= 95,500 BTU

FIGURE H. BTU CONVERSIONS [13]

Using the BTU conversion method, the AASA study found that the consumption for 1 square foot in 1979 was 104,445 BTU's. This figure is uncorrected for temperature differences which is significant since the United States Weather Bureau reported that the

FUEL SOURCES: ALL BUILDINGS

FUEL TYPE	NO. OF BLDGS. REPORTED AND PERCENTAGE N	%
NATURAL GAS	5999	54.99
OIL (ALL GRADES)	2734	25.01
ELECTRICITY HTG./COOLING	809	7.40
HTG. ONLY	962	8.80
PROPANE	220	2.01
COAL	168	1.54
BUTANE	19	.002
DIESEL	16	.0015
TOTAL VALUE	10929	99.65

FIGURE G.12

1978-79 winter was one of the two worst in the last fifty years.[14] Stephan's study done in 1975 showed a per square foot consumption in 1972-73 to be 161,312 BTU's. By 1974-75 consumption per square foot had dropped to 148,113 BTU's.[15] This drop in consumption is equal to 35.3%. Unfortunately the drop in consumption did not lead to a drop in energy bills.

One study of average energy costs per pupil has been compiled for selected years from 1969-1978. These costs are shown in Figure I.

	1969	1973	1976	1977	1978
Heat	7.38	7.94	17.53	18.79	22.82
Other Utilities	11.07	16.23	28.74	31.71	36.57
Total	18.45	24.17	46.17	50.50	59.39

FIGURE I: ENERGY COSTS PER PUPIL (NATIONAL AVERAGE) [16]

Based on Figure I, energy costs over the period 1969-1978 have risen almost 322%. School systems have not been forced, so far, to take drastic action to curtail the increasing energy costs. One of the things which could hve been done had there not been the drastic energy cost increases would be the hiring of more teachers. Stephan suggests that nationally in the 1973-75 time span, energy costs were equivalent to 43,200 teacher positions.[17]

Not all of the energy cost increases over the period 1972-1978 were due to increased fuel costs. At least one other factor is partially responsible for additional costs. Court required bussing has increased school energy costs. Legal activities making more students eligible for bus transportation is a second factor. Great difficulties exist in trying to determine what increased bussing costs. Some data exist showing pre-and post-desegregation transportation costs. Nine separate systems across the country were studied and over these systems, transportation costs rose a

little more than 16%.[18] The data used to prepare these costs are not directly applicable to total energy used within the system, but do, perhaps, show trends in increasing transportation costs.

The national energy picture looks somewhat gloomy as evidenced by costs increasing much more rapidly than they can be reduced by reduced consumption. Another factor which causes problems is the more than one-half of our existing schools built in the 1950's and 1960's. These 1950's-1960's schools were built during the period of rapid student growth when the prime concern was getting the building, not a quality building. Today a word which has assumed an important meaning for administrators is life cycle costing. In the 50's and 60's it was totally unknown or ignored.[19] Today, the idea of life cycle is getting to be one of the first things that is mentioned when new buildings or new pieces of equipment are considered.

Unfortunately, there are always excuses for not doing the things which are accepted as being the correct thing to do. One study attempted to catalogue the reasons for inaction relevant to non-energy saving. The respondants were not limited by a request for the main or primary reasons for inaction, rather they were encouraged to list all obstacles which would need to be surmounted prior to taking needed energy conservation steps. Having no funds to do needed repairs was the primary reason given by the administrators (60.8%). Next on the list was the fact that the buildings were old and very little could be done to improve their energy efficiency (54.8%). Lack of proper controls on heating and cooling systems was listed by just over half (50.6%) of the respondants as

the primary deterent to saving energy. Almost half (48.4%) listed leaky windows as something to overcome to save energy.[20]

In some cases the perception of obstacles is just as real as obstacles themselves. Survey respondants had listed only one comparatively easy area to solve--leaking windows. The other areas listed--no money, old buildings, and lack of proper controls -- are all capable of being little more than excuses. This is not to say that they may not be real, but they may be more excuses than reasons.

Enough real problems exist for school administrators without finding imagined ones. Some of these problems have no solution in the existing buildings set-up. Solutions can be found only through extensive restructuring or through a completely new building. Systems have apparently given little thought to placement of new school facilities, except as placement relates to politics.

A publication by the North Carolina Division of School Planning makes an astute observation about the difficulty of school placement:

> Local school administrators are constantly faced with the task of making decisions which maintain a delicate balance between quality education and economic efficiency.[21]

This programming approach allows administrators to evaluate the impact of various constraints which might be placed on new facility location. Any number of constraints may be applied as long as they do not conflict. The addition or deletion of constraints through the computer program allows school officials to maximize the desired objective in actual placement of the school plant. Unfortunately, there are within the computer program no cababilities to decide which constraints are most important. In other words, is bussing for racial balance more important than community-based

schools to save energy.[22] This decision and others requiring trade-offs(decision optimization) can only be decided by the administration with, in some cases, court intervention or other legal constraints.

These constraints are hardly trivial in terms of dollar cost. In Jefferson County, Kentucky, after court-ordered bussing, the cost and the number of miles traveled per day doubled. In Dallas, Texas, the additional cost of desegregation, mostly attributed to bussing, amounted to $500,000 per year.[23]

While dollar costs are not directly equateable to human costs, the very fact that a significant number of dollars must be spent to obey the law makes school placement important. Site selection is one way, if properly conducted, which can minimize the cost of gasoline used for desegregation purposes.

Once a site has been selected, the process of selecting architects, approving bids, and then constructing the building can begin. All these processes can minimize energy use if properly carried out. Most areas have building codes which must be obeyed, however, in some cases going beyond the required features can save substantial money for the district. One of the most ambitious plans calls for the use of an Energy Use Index (EUI) of 75,000 BTU's per square foot for existing buildings and 55,000 BTU's per square foot for new buildings. Current usage in schools ranges from 75,000 BTU's to 500,000 BTU's per square foot.[24] As was noted earlier, the median usage as shown in the American Association of School Administrator's study was 104,000 BTU's in 1978, down from 168,000 BTU's in 1973.

The concept of Energy Use Index (EUI) allows comparisons to be

made on the same basis regardless of energy source. The principle of the EUI uses an accepted engineering unit, the British Thermal Unit (BTU), to compare fuels with various methods of measurement--gallons, cubic feet, kilowatt-hours, tons.

It is the responsibility of the superintendent and the school board to emphasize the fact that energy conservation is an important constraint in the design. If this is done the designer can be asked to present an energy use comparison based on certain design specifications. In choosing only the heating, cooling, and ventilation system (HVAC) there are a number of choices which can be made. There are at least six types of all air systems; at least two types of air-water systems; two all water systems; and two refrigerant systems.[25] Each of these systems was designed for specific purposes and a competent designer would be able to recommend the least energy intensive one for a particular application.

No matter how complete the study or how good the advice, if the builder does not follow the correct procedures, the outcome will be less than acceptable. All too often, says one critic, public buildings are built by the <u>cheapest</u> bidder. The result is a cheap building. Because of past abuses there exists the legal requirement in almost every state that the bids for public buildings be done in a competitive manner. Time restrictions and public relations considerations make it almost mandatory to accept the low bid. A critic of the system contends that the use of bidder prequalification would eliminate a number of these unqualified and underqualified bidders.[26]

An administrator must understand that even with qualified builders it is still possible to get a building which is not energy efficient

or one that is extremely difficult to control. Controls can have a significant impact on the operating efficiency of a system. According to one engineer, the best controls are those which operate automatically, utilizing time clocks or similar devices. [27]

Automatic controls might provide a solution to the problem experienced in small districts (< 5000) of greater energy use. The AASA study reports that these small districts use 11.6% more energy (per square foot) than districts with greater than 5000 pupils. This result prompted AASA to suggest that it might be necessary for educational agencies to provide greater support for a technical staff of energy experts.[28] These experts would come from outside the normal staff allotment of the district. If energy savings of almost twelve percent are possible, then it would seem to be a wise use of resources for state agencies to provide such a person. This individual could be responsible for energy in a rural region where there might be several small districts, none of which could afford a full time staff person.

Conclusions of AASA based on their survey, are that reductions in energy consumption (down 35%) from 1973-78 are due primarily to changes in operations, more energy conscious maintenance, and implementation of low cost retrofits.[29] If the AASA conclusions are correct, then it seems that most of the <u>easy</u> conservation steps have been taken. Many sources for energy plans exist. Plans range from rather general to somewhat more specific. From an historical standpoint, the plans are significant and, for those few systems which have not yet implemented them, very valuable guides.

Figure J. shows the most comprehensive approach of the various plans.

-conduct physical inspection of the school plant
-determine the effectiveness and efficiency of all mechanical systems
-close shades/blinds during very hot or cold weather
-review the temperature settings on all thermostats
-reduce lighting levels where possible
-setback thermostats for nights and weekends
-keep all outside dampers closed when buildings are unoccupied
-reduce outside air intake to minimum code
-re-evaluate morning warm-up
-set hot water heaters to lowest temperature possible
-schedule custodial activities for daylight hours
-consider restructuring school day and year
-spend some money and get a complete energy audit
-investigate building rennovation or new building

FIGURE J. SYSTEM SAVING PLAN[30]

Suggestions for implementing the steps listed in the plan are abundant. Almost every journal dealing with plant maintenance or system supervision has listed exemplary activities. One gives rather specific suggestions based on possible federal reimbursement for energy conservation. As an example of the specific nature, consider the lighting suggestions.

-keep lights and fixtures clean, as dirty lights can reduce light by 50%
-replace lamps before they burn out since they give progressively less light. A rule of thumb is replace at 70% of rated life
-replace all lamps in a system at the same time, reducing labor costs and getting more light
-get more efficient lamps
-get new fixtures (flourescent a must)
-replace single controls with zone controls [31]

Another journal suggests (complete with check lists) that all levels in the schools from superintendent to custodian get involved and have specific tasks.[32] Others suggest computer simulations and mini-audits.[33]

A suggestion made for a phase approach to saving made by Moses seems to be very promising as far as getting psychological commitment from all involved parties. Moses' two phase approach starts

with management commitment in the first phase and a total master restructuring for energy conservation in phase two.[34]

Moses also suggests that schools have been able to save 10%-15% in fuel doing a relatively few things. Some with very innovative approaches have saved as much as 30%. Moses contends that as much as half again could be saved if we did more than look superficially at the total problem. There are three "energy facts of life" which Moses says administrators have not yet learned. Our behavior gives testimony to his allegations of neglect of these facts:

FACT 1: There is a limited amount of fuel available for school use.
FACT 2: Alternatives to current sources of energy are effectively years away.
FACT 3: Cost for energy is rising and will continue to do so into the foreseeable future.[35]

Based on the "facts of energy life" and on Fredrickson's admonitions not to even consider building renovation, unless there is at least fifteen years of life left in the structure and to postpone even minor renovation unless the building has five years of service left, seem gloomy.[36] What this may mean is that schools may use an ever increasing part of their budget to meet energy costs. Program and salary increases will be directly tied to the local community's ability and willingness to increase the school share of the tax allotment.

Several approaches for administrators do exist despite the rather gloomy projections of Fredrickson. Four approaches exist. The first is do nothing--the "ostrich" approach. Since this is not productive at all, it can be discounted as a desirable alternative. The other three are all positive approaches and can be implemented sooner or later by all school districts regardless

of size or wealth.

Perhaps the easiest way to increase cost effectiveness is to replace old lighting fixtures with new ones. Payback periods, the time needed to recover the capital cost plus interest in energy savings, will vary with the project, but, generally, are in the range of five to ten years. An example by Zackrison shows the math.

> Plan: To replace a 500 watt incandescent floodlight with a 100 watt high pressure sodium lamp which produces basically the same number of lumens.
> .cost to convert is $213.00(includes lamp, all fixtures, and labor.)
> .The replacement will reduce operating costs by $60.00 per year.
> .If we assume the money is available and no financing is required, the payback period is equal to 3.6 years. 37

This type of calculation can be performed for any remodeling or renovation project to determine if the cost of the project is justified by the energy saved.

Another savings method revolves around operational activities in the schools. Operations can be as simple as fuel contracts being based not on gallons or cubic feet but on energy or BTU content,[38] or as complicated as changing the school year. One method suggested by Eaton concerning school year modification deserves further study. Eaton's approach takes to task those persons who wish to close schools in cold winter months in order to save energy. His proposal is to close in the warm summer month of May. The reasoning is that heat must be supplied in all the winter months to prevent freezing, whether the building is used or not. Arithmetic calculations show that Eaton's proposal makes

sense. He has found that a particular building uses one hundred gallons of oil for heating per degree day (degree day = number of degrees the average temperature of the day varies from a standard; usually 65 ° F). His calculations are set forth in Figure K, including the 43,000 gallons used regardless of heating for kitchen, etc.

TIME	DEGREE DAYS	OIL USAGE (gals.)	MODE	OIL SAVED	$-SAVED
30 days in winter	1297	173,000	15° F setback	45,000	$18,000
30 days in May	240	81,660	shutdown	81,660	$32,664

FIGURE K. SUMMER VS. WINTER SETBACKS

Eaton contends that not only are more oil and dollars saved, a potential trouble spot is also avoided. A building at 50° F cannot have an electrical power failure to the heating pumps or circulators without creating a substantial problem and very high costs.[39] Winter conditions are much more likely to create such an electrical failure and more than offset energy saved from the shutdown.

Innovation in operations must be encouraged if costs are to be minimized in the short run. Really long term cost reductions are handled only through new, more efficient building programs. Here, as well as in operations, pay back must be considered.

Enough demonstration projects have been done or are currently on the drawing board to give the decision makers data for their decisions. One of the biggest solar projects was built in Reston, Virginia. In addition to being solar, this building was built inside a hill and a heat reclamation system was installed. If the solar component is not considered, up to 50% of the normal fuel

costs can be saved with the other features. Not including solar, the school's construction cost was still at the national average of $34-$36 per square foot.[40]

Two nearly identical schools built with essentially identical locations and with similar populations show a substantial savings in capital costs. It is assumed that operational savings would also be substantial. A summary of these savings is in Figure L.

Savings Due to Insulation	
. delete 82 tons of air conditioning	$57,500
. reduced electrical requirements	4,900
	-62,400
Costs Due to Insulation	
. urethane foam roof deck	27,000
. foam board walls	33,900
	+60,900
Capital Savings	$ 1,500

FIGURE L. COMPARISON OF SAVINGS VS. COSTS IN INSULATION

It should be noted that not in every case, perhaps not in many cases, do capital costs in energy conservation show such a positive figure. There needs to be an understanding among administrators that energy savings do not always equal dollar savings. This is an extremely difficult concept to accept, since the assumption which holds true for many goods and services, namely "the less you use, the less you pay," does not always work in energy matters.

From a state level, there has been an attempt to educate the educators vis á vis the energy situation. The first substantive

effort came as part of the North Carolina Energy Plan. The author was involved in the formulation of one of the early drafts of the plan and has some knowledge of the thought behind the proposal. Two focal areas make up the main part of education's share in the plan. Area one is " designed to devise, revise, and/or reinforce measures to reduce energy consumption in school operation." Area two was planned "to educate students, staff, and community to the factors and issues relating to the energy problem."[42]

Plant operations (area one) was the one area where immediate improvement could be expected. Goals were set and engineers hired to help the Local Education Agencies (LEA's) meet the goals. Actual usage within an LEA would be compared to a norm and suggestions made for improvements. This usage would be supplied to the superintendents allowing them, or their energy designee, to monitor usage among their buildings.[43]

Continuation of the superintendent's workshops begun in 1972, was a main component of the education section. These workshops were expanded to include maintenance supervisors and business managers.[44]

The educational curriculum component was likewise implemented based on recommendations found in the plan. An energy consultant was hired to help design the academic aspects of the program. The author held that position for a time in 1977-1978. Programs dealing with the psychological aspects of energy conservation were planned and their implementation continues. Curriculum, however, is an area where there exists difficulty of quantifying input and output. There seems little doubt that some conservation within the schools has resulted from this program, but it is readily admitted

that no one knows how much.

State action has not been limited to the formulation and implementation of the State Plan. There are a number of public laws passed by the legislature over the years, which contribute either to energy usage or savings. In almost all cases, the energy implication of the law is clear. Following will be a brief description of the laws and their potential impact on school systems within the state. Implications are conjectural, based on the author's experience as state energy consultant and as a supervisor in the Corporate Communications Department of one of the state's electric utilities.

II. PUBLIC SCHOOL LAWS

This section will follow the commonly accepted practice of citing specific parts of the laws by section number (i.e. 115-114).

115-11.1 - The State Board is authorized to expend public funds to defray reasonable costs of motor vehicle transportation for autistic and communications handicapped children and deaf and blind children to the nearest proper public educational institution located within the state.[45]

Potential impacts from this provision on bussing costs have been limited due to trends within the educational community to integrate these children into the normal classrooms.

115-36 - A normal school day will consist of a minimum of six hours except for handicapped students and those from kindergarten through third grade. Specific hours of operation are left to the discretion of the local board. A school term will consist of 180 days; no more than 60 days may be suspended by the Superintendent.[46]

This section severely limits the ability of local administrators to develop new calendars or schedules. The law does not give educational reasons for the six hours per day, nor for the one-hundred-eighty days per year. This provision might be changed if any innovative methods outside the legal mandates prove useful.

115-51- All food services shall be operated on a totally non-profit basis.[47]

As a large consumer of energy, food services might seem not to qualify. The energy expended in the operation of school cafeterias is simply another area where examination might yield savings.

115-52.1- Activity buses are to be purchased through the use of local funds and serviced in the local garage; however, the State Public School Fund will be reimbursed for all maintenance costs including labor, gasoline, oil, repairs, etc.[48]

Each year field trips, athletic events, and similar activities utilize the local activity bus. Local costs were considered appropriate for the maintenance and operation of these vehicles. A question immediately can be posed as to what extent the school program would suffer were gasoline costs to double. Which of the activities would be cut--all equally, or would some be entirely eliminated while others received no cuts? Decisions will need to be made relative to desirability. The author has noted a large decrease in the number of school groups requesting tours of generating facilities. Data sufficient to quantify this observation do not exist currently.

115-73.6-115-73.12- A purpose of the Community Schools Act is to encourage greater community involvement in public schools and greater use of public school facilities.[49]

The provisions in the Community Schools Act (115-73) can greatly add to the LEA's energy costs. If the community does, indeed, make greater use of the physical plant for night and weekend meetings, the normal control regime for heating and cooling will have to be altered. These off-school hours uses will cause

the expenditure of more energy. As more school systems go to computer modeling for energy comparison, community use must be factored in for a true picture of cost per instructional hour, or per pupil, or some other quantifier.

115-76. This section lists the reasons for consolidation of schools and the discontinuance of schools. A number of factors are listed, but only slight mention is made of transportation costs as a reason, and this is the only energy reason given at all.[50]

Earlier in the paper, there was mentioned the possibility of closing schools simply because of their highly intensive nature. This provision of North Carolina state law seems to prevent energy from being considered in these decisions except circumferentially, as related transportation. A future legislature may find a need to revamp the discontinuous reasons to include excessive energy use.

115-100.6 Budget is the topic of this section. Authorization for expenditures not in conflict with State Board policies or local board policies is granted.[51]

Provisions in this section make possible the expenditure of funds required for various types of increased energy costs. As long as use energy does not exceed the guidelines set by either the state or local board, they may continue for payment. In theory, at least, the State Board could prohibit a large amount of non-essential use through a simple board policy.

115-129- The duty of boards of education to provide for the nine months school term is clear and requires

suitable buildings, equipment, and furniture. Compliance of the buildings to applicable provisions of the North Carolina State Building Code and local buildings and electrical codes is also mandated.[52]

The provisions of 115-100.6 made it possible to spend funds for building operations. This section requires such expenditures. Compliance with both state and local building codes may, over the long term, have considerable impact on total energy consumption.

115-180- School boards are authorized, but not required, to provide transportation for students.[53]

If bussing were eliminated, there would probably be a great outcry; however, there is no provision within the state law which requires local boards to provide such a service to the students.

115-186- Plans for the most efficient use of buses, where bussing is provided, are required. Routes shall be drawn so as to pass within one mile of all pupils living 1½ miles or more from the school.[54]

Setting the restrictions listed of bus routes being one mile from all pupils living 1½ miles or more from school, opens up tremendous possibilities for saving gasoline. Parents whose children would have to walk, perhaps two miles to school or 1½ miles to the bus stop might be agitated to some action. No legal basis for such action seems to exist within the provision of this section.

115-202- Driver's education has become an accepted part of the curriculum. Its provision is guaranteed by this

section. Local boards are to pay the expenses from instructional service and current expense accounts.[55]

According to data presented earlier in this paper, driver's education, on a national basis, requires 18,000,000 gallons of gasoline yearly. Boards must examine the quality of expenditures for all energy, not just driver's education, and determine whether the dollars spent are buying a truly good education.

105-449- This section, not directly associated with the Public School Laws, is important in that it provides the legal basis for exempting school-use gasoline from state taxes.[56]

If a desire is expressed to make a tax adequately reflect costs, there is no justification for this exemption. Since all gasoline tax dollars are put into a highway trust, school use of roadways is being subsidized. If the tax is justifiable and equitable, school use should pay its own way for its use of the highways.

143-129- When letting bids the"... award shall be made to the lowest responsible bidder or bidders, taking into consideration quality, performance, and the time specified in the proposal for performance of the contract."[57]

As was mentioned earlier, this provision for acceptance of the lowest bid, sometimes gives a poorer quality in the finished product. Section 143-129 does provide an avenue for not accepting the lowest bid. The "... consideration of quality, performance..." is a way to get better construction.

From the foregoing discussion, it is rather apparent that, while a number of laws could impact the schools and their opera-

rions from an energy standpoint, few make much of an impact.

There are other legislative or quasi-legislative actions which can also influence energy use in the schools. These actions range from federal activity in limiting temperatures to 65° F in winter and 78° F in summer.(Elementary schools were specifically exempted from compliance and penalties)[58], to rate setting action by the Public Utilities Commission.

Each of these actions has the potential for a large impact on the schools. Administrators need to be aware of what these possible areas of influence are, and how to minimize their economic impact on the system. Two areas of prime importance for administrative action deal with rates and building codes. At times, the criticism of rate structures being written to be incomprehensible, seems valid. Take, for example, the statement from the Carolina Power and Light Rate Book:

> The Billing Demand shall be the maximum KW registered or computed, by or from Company's metering facilities, during a 15-minute interval within the current billing month. However, the Billing Demand shall not be less than the greater of (1) 80% of the maximum monthly 15-minute demand during the billing months of July through October of the preceding eleven billing months or (2) 60% of the maximum monthly 15-minute demand during the billing months of November through June of the preceding eleven billing months or (3) 75% of the Contract Demand until such time as the Billing Demand first equals or exceeds the effective Contract Demand, or (4) 50 KW.[59]

Building codes are somewhat clearer and more precise, and yet, they too require more indepth knowledge than the average administrator possesses.

North Carolina is very lucky to have a Division of Plant Operations which can help systems understand fuel use, costs, and conservation techniques. This division operates for all districts

but is particularly important for smaller ones which cannot afford a permanent energy expert. The Division of School Planning serves a similar purpose in the area of new plant construction, bussing routes, and similar activities.

The local administrator is not expected to become an expert, but does need some basic background knowledge on the energy situation. Information on saving dollars and energy should be foremost in the administrator's mind. Unfortunately, based on the author's experience, this basic knowledge is lacking. There is more misinformation, or half-understood ideas, than information.

Note to Dr. Pittillo:-Bob- This is to be the introduction to my dissertation. Other chapters will cover what the administrator needs to know (rates and building codes); what the administrator knows about energy (a survey); compilation of N.C. energy information, similar to the AASA's national study.

FOOTNOTES

[1]Calvin E. Anderson, "The Impact of the Energy Crisis on School Finance," Phi Delta Kappan 57 (November 1975): 193.

[2]Ibid.

[3]Ibid.

[4]Ibid.

[5]William D. Curzie, Jr., "Energy Ethics and School Dollars," American School and University 49 (December 1976): 38-40.

[6]Anderson, "Impact of Energy Crisis," p. 194.

[7]American Association of School Adminstrators, AASA Energy Use Study, (Arlington, VA: AASA Office of Governmental Relations, August 1979), p.5.

[8]Ed Stephan, "The Impact of Rising Fuel Costs," American School and University 49 (December 1976): 34.

[9]Ibid.

[10]AASA Energy Use Study, p. 12.

[11]Ibid., p. 10.

[12]Ibid., p. 8.

[13]Stephan, "Impact of Rising Fuel Cost," p. 37.

[14]AASA Energy Use Study, pp. 1-3.

[15]Stephan. "Impact of Rising Fuel Cost," p. 37.

[16]Paul Abramson, "Seventh Annual Maintenance and Operations Cost Study," American School and University 50 (March 1978): 37.

[17]Stephan, "Impact of Rising Fuel Cost," p. 37.

[18]Alauson A. Van Fleet, "Student Transportation Costs Following Desegregation," Integrated Education 90 (November-December 1977): 75.

[19]Manfred Moses, "Beating the High Cost of Energy in Schools--Why It Must Be Done and How To Do It," The American School Board Journal 164(April 1977): 28.

[20]Stephan, "Impact of Rising Fuel Cost," p. 37.

[21]J. L . Pierce, A Programming System for School Location and Facility Utilization, (Raleigh, NC : Division of School Planning, Department of Public Instruction, 1977), p. 1.

[22]Ibid., pp. 1-4.

[23]Van Fleet, "Transportation Costs," p. 77.

[24]James E. Piper, "The Energy Audit: What It Can Do for You," American School and University 50 (March 1978): 58.

[25]Ish Sud, "Principles of Heating, Ventilating, and Air Conditioning," In Short Course on Energy Conservation in Buildings, (Durham, NC: Duke University Center for the Study of Energy Conservation, 1977), p. 4.

[26]John G. Arens and S. Harold Jones, "How to Protect Yourself from Unqualified Contractors," American School and University 49(July 1977):34-35.

[27]Sud, "Principles," pp. 7-8.

[28]AASA Energy Use Study, p. 6.

[29]Ibid., p. 3.

[30]John H. Fredrickson, "Facilities Recycling for Energy Conservation," NASSP Bulletin 63 (May 1979): 61-62.

[31]Harry B. Zackrison, "Potentially Bright News: Uncle Sam Might Help You Pay for Improvements in School Lighting," The American School Board Journal 166 (January 1979): 33-34.

[32]University of the State of New York, "Energy Usage Guidelines: Educational Institutions," (Albany, NY: University of the State of New York, 1974), pp. 4-9.

[33]Marilyn Kerns, Energy Conservation: An Examination of Energy Conservation Mechanisms As They Relate to School Districts in Region XI,(St. Paul,MN: Minnesota University, 1974), passim.

[34]Moses, "Beating Energy Cost," pp. 29-30.

[35]Ibid., pp. 28-29.

[36]Fredrickson, "Facilities Recycling," p. 63.

[37]Zackrison, "Bright News," p. 34.

[38]Irving Fallon, "Save Money With This Fuel Oil Spec," American School and University 50 (February 1978): 62.

[39]Maxwell Eaton, "Setback vs. Shutdown: The Case for May," American School and University 49 (July 1977): 36-38.

[40]Gregg W. Downey, "Some Sunshine for Your Fiscal Life," The American School Board Journal 164(August 1977): 56.

[41]Stanley O. Bokelmann, "Savings Can Pay Cost of Insulation," American School and University 49(July 1977): 24-25.

[42]North Carolina Energy Division, North Carolina Conservation Plan, (Raleigh, NC: North Carolina Department of Commerce, 1977), p. 62.

[43]Ibid., p. 64.

[44]Ibid., p. 65.

[45]North Carolina State Board of Education, Public School Laws of North Carolina, (Charlottesville, VA: Michie Company, 1978), p. 25.

[46]Ibid., p. 42.

[47]Ibid., p. 47.

[48]Ibid., p. 48.

[49]Ibid., p. 57.

[50]Ibid., pp. 62-63.

[51]Ibid., pp. 67-68.

[52]Ibid., pp. 100-102.

[53]Ibid., p. 155.

[54]Ibid., p. 163.

[55]Ibid., p. 171.

[56]Ibid., p. 312.

[57]Ibid., p. 426.

[58]U.S. President, Executive Order, "Emergency Building Temperature Restrictions," Federal Register 44, no. 130, 5 July 1979, p. 39355.

[59]Carolina Power and Light Company, Rate Schedules, (Raleigh, NC: Carolina Power and Light Company, 1 July 1979).

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